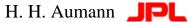


AIRS Science Accomplishments Version 4.0/ Plans for Version 5

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Spacecraft: EOS Aqua

Instruments: AIRS, AMSU, HSB,

MODIS, CERES,

AMSR-E

Launch Date: May 4, 2002

Launch Vehicle: Boeing Delta II

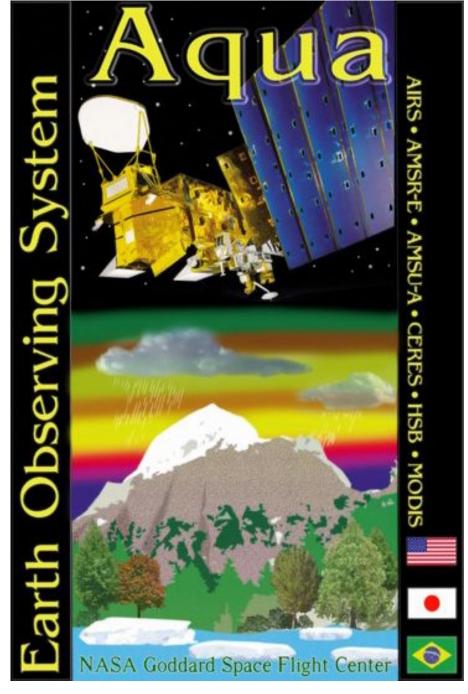
Intermediate ELV

Mission Life: 5 years

Team Leader: Moustafa Chahine

AIRS Project Objectives

- 1. Support Weather Forecasting
- 2. Climate Research
- 3. Atmospheric Composition and Processes





This talk is about accomplishments with AIRS V4.0 data and what we have learned from almost three years of data what part of this is emerging in Version 4.0 and what part we would like to see filtering into Version 5.0



Calibration and Radiometric Performance

Weather Forecasting

T(p), q(p) retrievals

Research Products

Climate Application

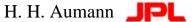


AIRS Calibration and Radiometric Performance

The AIRS calibration accuracy at the 100mK and stability at the 6 mK/year level are amazing. It establishes the unique capability of a cooled grating array spectrometer in Earth orbit for climate research.

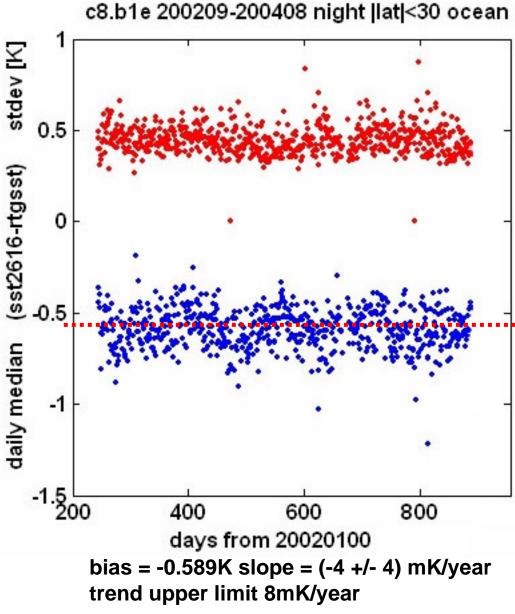
Data which are sufficiently clear to match the radiometric accuracy of the instrument, have a yield of less than 1%. This is OK for calibration. The 2616cm-1 window channel combined with the RTG.SST for tropical ocean allow excellent assessment radiometric calibration accuracy and stability.

For absolute calibration verification 100mK is the limit due to cloud contamination. The 10 micron window channels can be used for stability assessment, but accuracy is limited at 300mK due to water continuum absorption uncertainties.





2 years of AIRS SST compared to RTGSST shows impressive measurement stability



stdev(sst2616-rtgsst) = 0.413K

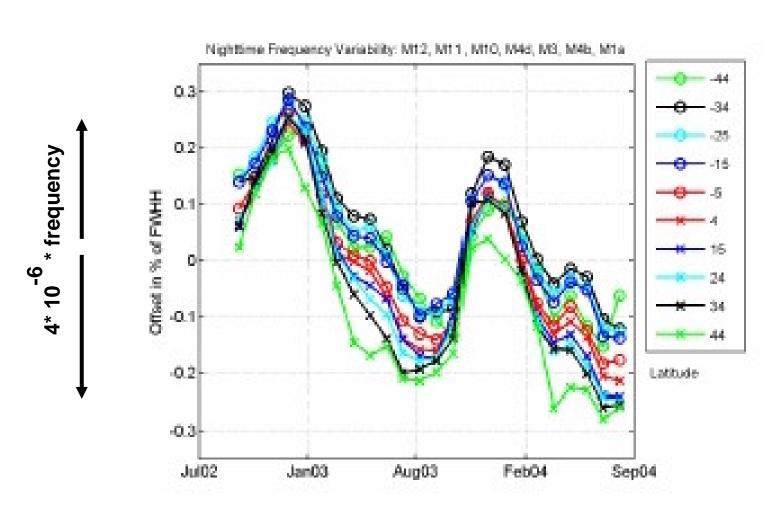
0.4K of the 0.6K cold bias is expected since the rtgsst at night is warmer than the skin measured by AIRS

>3K outlier rate is less than 1:1000

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The 4* 10-6 * frequency peak-to-peak SRF centroid variability with season and the long term trend of 1* 10-6 * frequency/year should be included in Version 5, Level 1b PGE





Weather forecasting

AIRS is showing forecast impact in the northern and southern hemisphere.

The 320 of 2378 AIRS channels transmitted to NWP carry 99% of the information. Currently NWP want calibrated radiances with stable noise characteristics. Radiance bias tuning is employed..

JCSDA Forecast Impact

Joint Center for Satellite Data **Assimilation (JCSDA) NCEP Operational Model**

"A several hour increase in forecast range at five or six days normally takes several years to achieve at operational weather centers"

"This magnitude of improvement is quite significant when compared with the rate of general forecast improvement over the last decade".

John Le Marshall in EOS, March 15 2005, Vol 86, No 11

IN THIS ISSUE: Preparedness and Mitigation Systems for Asian Tsunami-Type Linking the Scales of Observation, Process, and Modeling of Dust Emissions, Pg. 113 Outstanding Student Paper Awards, Pg. 115

VOLUME 86 NUMBER 11 15 MARCH 2005

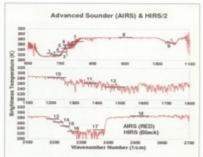
Landslide Surveillance: New Tools for an Old Problem

ebilde in Salmon Falls Creek Carson, klabo

10 km west of the town of flight in wouth one ted Maho, is a careeouries state description born the read skin of Salmon Falls Creek. most of its length. However, the carpon wides dramatically to well over 1 lam along a files stretch of the Salmon Falls Creek known as Sinking Careon* (Flguer 1).

Impact of Atmospheric Infrared Sounder Observations on Weather Forecasts

by this instrument is seen in Figure 1 when

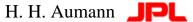




T(p), q(p) retrievals

Cloud-clearing AIRS data with AMSU produces RAOB quality retrievals in the lower troposphere with 50% yield

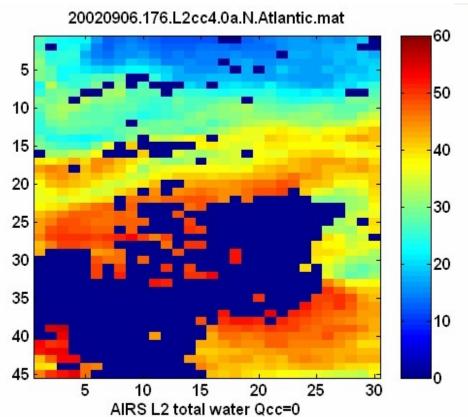
validated over non-ocean validation over land in progress validation of polar areas in Version 6.0





Where AIRS returns a (Qwater==0)|(Qcc==0) solution it is not very cloudy

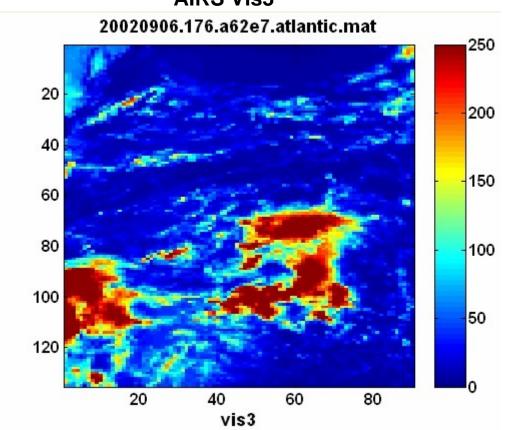
AIRS L2 total water Qcc=0



AIRS total water granule stats 36.1+/-12.8 range =[11.2 55.5] mm

68% of the area yield a solution which passes QC

AIRS Vis3



AMSRE total water granule stats 39.1+/-12 range=[11.7 56.1] mm

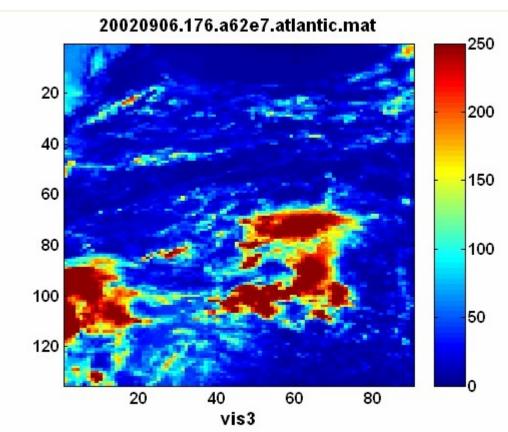
80% of area yield a solution which passes QC





Where AMSRE return valid solutions, it is not very cloudy

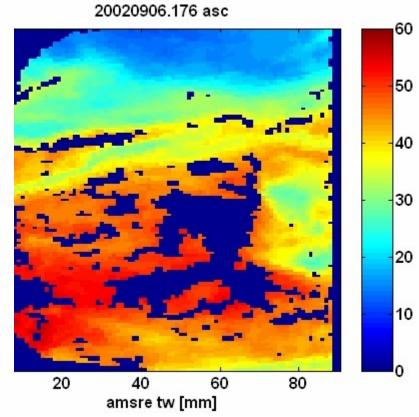
AIRS L2 total water Qcc=0



AIRS total water granule stats 36.1+/-12.8 range =[11.2 55.5] mm

68% of the area yield a solution which passes QC

AMSRE total water



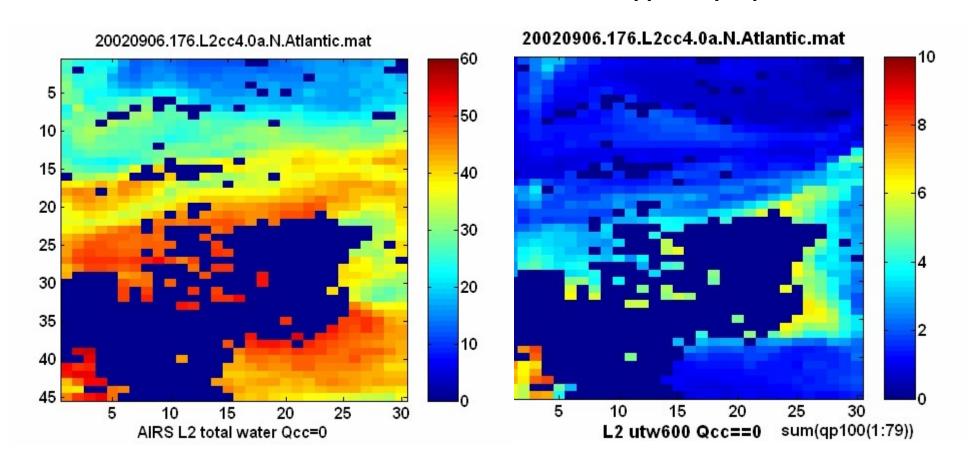
AMSRE total water granule stats 39.1+/-12 range=[11.7 56.1] mm

80% of area yield a solution which passes QC





Unlike AMSRE the AIRS retrieval also returns upper tropospheric water



Validation of upper tropospheric water is a hotly debated subject





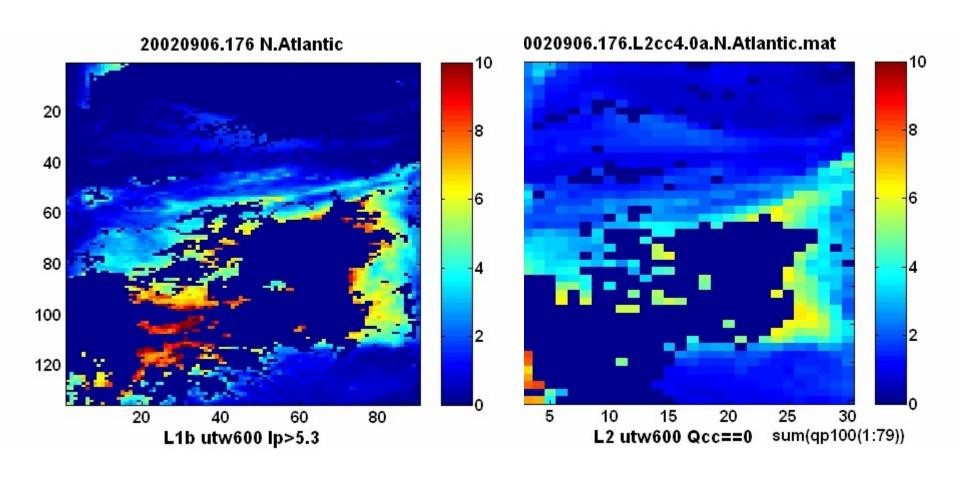
The V4.0 retrievals over ocean have verifiable statistical RAOB quality.

A validated, quantitative uncertainty estimate for the Level 2 products is key for subsequent optimal use of the data.

This is the topic of a focus team, for a Version 5.0 PGE upgrade.



If 30% yield is acceptable, retrievals can be made without AMSU and at the full AIRS 15 km spatial resolution



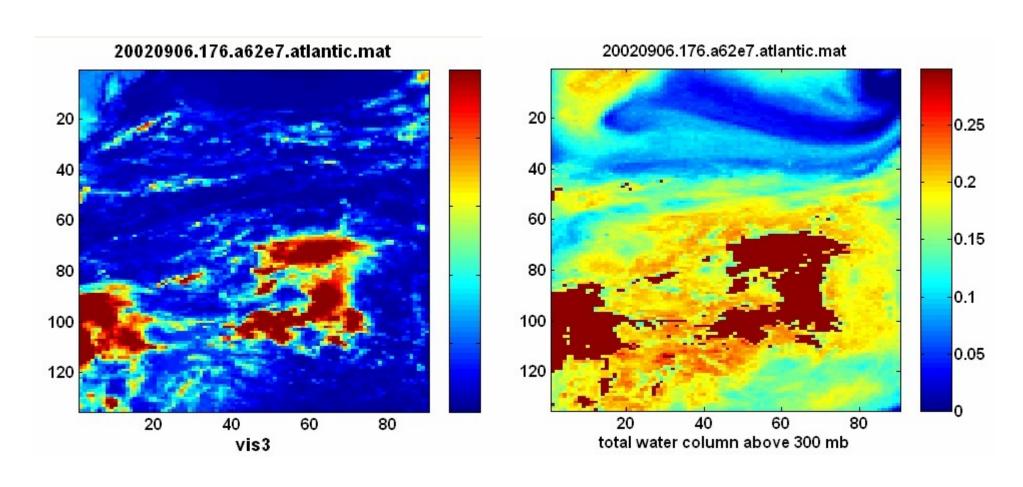
bt2388-bt1392 is used to retrieve the water column above 600mb from L1b data with 15 km footprints granule average 1.5 mm. Layers summed from 0 to 555 mb from the L2 Qcc=0 retrieval

Granule average 1.6mm

H. H. Aumann



If 30% yield is acceptable, retrievals can be made without AMSU and at the full AIRS 15 km spatial resolution



tropical granule median = 0.17 mm





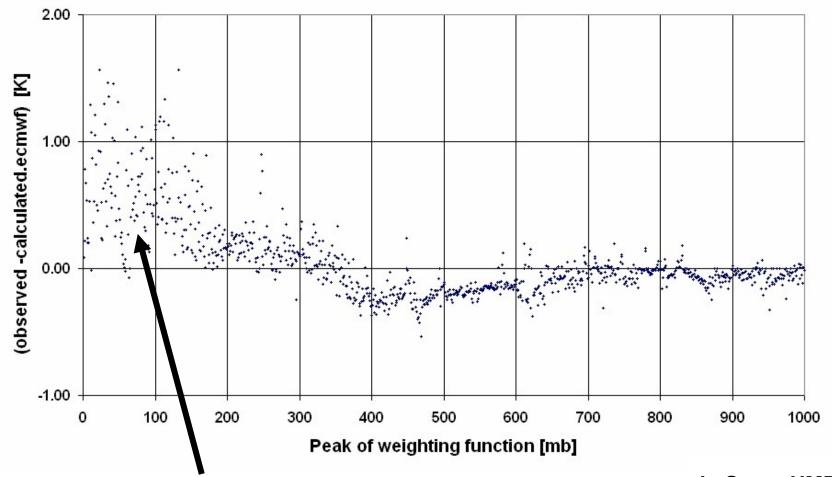
An AIRS focus team has been formed to evaluate making retrievals without AMSU as a backup to a potential AMSU failure and to explore the potential returns from higher spatial resolution.



Is the (observed-calculated) bias in the AIRS data real or an artifact of the assumed truth?

(Observed - calculated) using ECMWF statw adjusted T(p), q(p) profiles for cloud-free +/-40 degree ocean for all AIRS channels

mean=0.002K stdev=0.29K



AIRS is about 1K warmer in the stratosphere than ECWMF

L. Strow UMBC

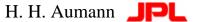


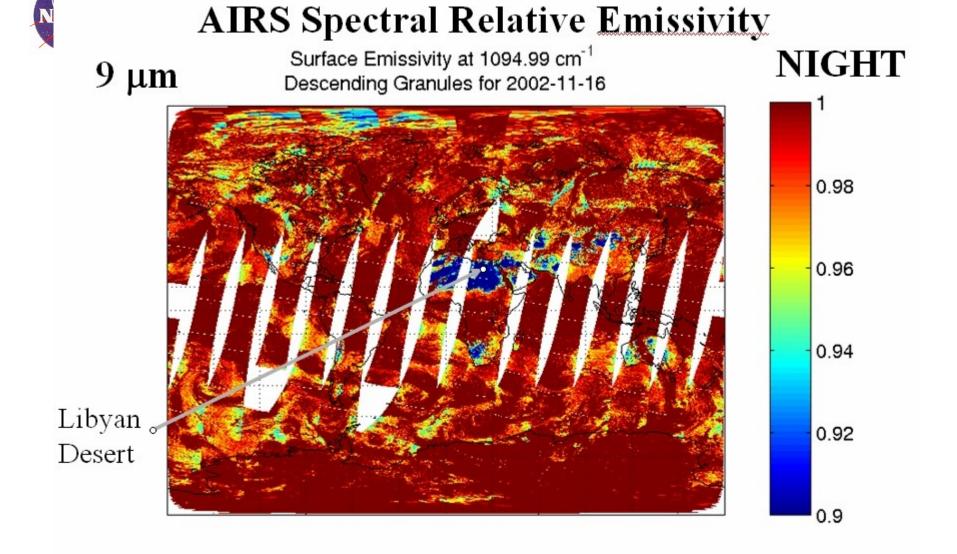
A focus team has been formed to analyze and make recommendations on

The need for empirical tuning of AIRS radiances in the L2 retrieval

How to handle the increase in the co2 abundance, which makes the AIRS co2 channels colder by 100 mK/year

Another focus team has been formed to analyze and make recommendations on how to deal with emissivity.





AIRS Focus Day: 16 November 2002 -- Descending



Research products can be upgraded to standard products

Potential Products co2

so2

methane

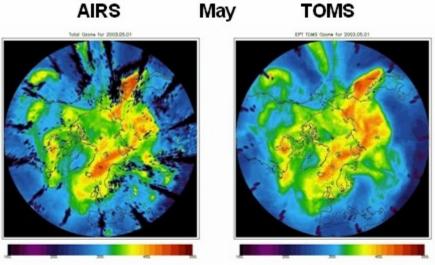
CO

aerosol



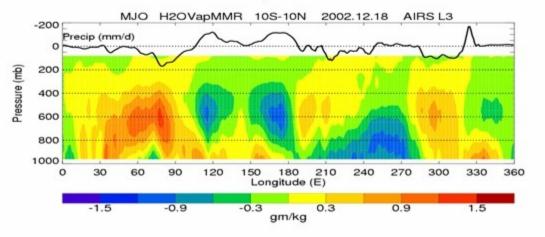
AIRS Ozone Matches TOMS

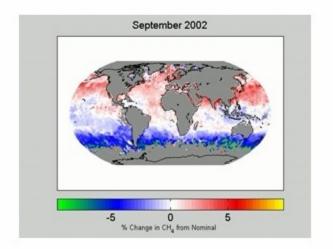
AIRS Observes SO2 from Anatahan April 6, 2005 TOMS



AIRS Data used to study Madden-Julian Oscillation

AIRS First Global CH4









Climate

The quality of the AIRS radiances for climate applications is assured.

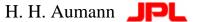
With more than 2 years of data it is time to focus on distilling the essence of the AIRS data for climate.

This essence is found in trends, correlations, processes, and the identification or verification of feedback mechanisms

Is the Lindsen hypothesis correct?
Is cooling in the stratosphere correlated with increased water vapor Is upper tropospheric water vapor (UTW) increasing Is there a correlation between OLR and UTW?

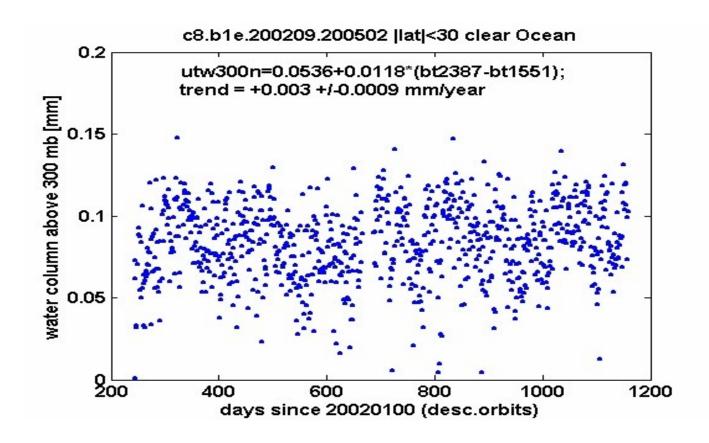
Level 3 products are a good step, but not the solution

Subset data products, like the new clear data subset, are a good step, but not a solution





Evaluation of AIRS data for climate requires analysis of very large amounts of data



The water column above 300 mb appears to be increasing at the rate of 0.003 mm/year in the last two years. No strong seasonal variability,





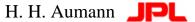
What AIRS design specs would we change for the next version?

A little more spectral resolution would help in the water band. Increasing the spectral resolution in some key areas will help with minor gas retrievals.

A little more spatial resolution would help. The inhomogeneity of the water field at 15 km scale is obvious in the data

The raw data volume is becoming a serious cost driver for data analysis. Develop an algorithm for onboard filtering of the data. Higher spectral and spatial resolution can not be utilized without solving the data overload problem.

Spectral coverage in the 4 and 14 micron CO2 bands is highly redundant.





Summary

Calibration and Radiometric Performance: Superb

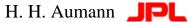
Weather Forecasting: Operational Forecast Impact Achieved

T(p), q(p) retrievals: RAOB Quality verified over ocean

Research products: Emerging

Climate Application: This should be the focus for the next few year

Now we need to update the AIRS Algorithm Theoretical Basis Document





Thanks for your attention

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